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FORECASTING CONSUMABLE ITEM TRANSFER IMPACTS

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OPERATIONS RESEARCH AND ECONOMIC ANALYSIS OFFICE

DEPARTMENT OF DEFENSE
DEFENSE LOGISTICS AGENCY

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DLA-LO

FOREWORD

This report documents the development of a computer simulation of key Defense Logistics Agency (DLA) supply center processes and backlogs. The Red Flag Model was developed to provide the DLA Consumable Item Management Office (DLA-OM) and the four DLA hardware supply centers visibility of potential workload problems which may develop as a result of the Consumable Item Transfer. The Red Flag Model is so named because measurement of each key process or backlog is accomplished through the use of indicators which track the entire range of operating levels from normal to out of tolerance (i.e., red flag) levels. The model was developed by the DLA Operations Research and Economic Analysis Field Operating Activity (DLA-DORO) and has been installed at the four hardware centers.

The Red Flag Model is the product of the efforts of many people, too numerous to mention here. Special acknowledgements, however, go to COL John N. Stewart, USA, the former DLA-OM Program Manager who had the foresight to see a need for the model and to Ms. Ann Bradway, the former DLA-OM Supply Systems Analyst whose guidance and direction were critical during each stage of model development. Thanks also go to the four people listed below who provided invaluable assistance in the development of data and information essential to the success of the project.

Ms. Linda Grist, Defense Construction Supply Center
Ms. Pam Meredith, Defense Electronics Supply Center
Mr. Tom Brooks, Defense General Supply Center (DGSC)
Mr. Ed Dixon, Defense Industrial Supply Center

Finally, a special thank you goes to Mr. Frank Lotts, Director, Office of Planning and Resource Management, DGSC, who not only made it possible for DGSC to serve as the lead center for this project, but also obtained the computer simulation software required for DLA-DORO to develop the model and install it at the four hardware centers.

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EXECUTIVE SUMMARY

The Office of the Secretary of Defense directed the Military Services to transfer management of nearly one million consumable items to the Defense Logistics Agency (DLA) during the period FY91 - FY94. For DLA, overall responsibility for the Consumable Item Transfer (CIT) rests with the Consumable Item Management Office, Directorate of Supply Operations (DLA-OM).

Although an orderly transfer schedule was agreed upon, there remained some concern at DLA-OM that "bottlenecks" or "choke points" could develop within the four DLA hardware supply centers as a result of overtaxed resources. Therefore, based on a tasking from DLA-OM, the DLA Operations Research and Economic Analysis Field Operating Activity (DLA-DORO) has developed the Red Flag Model, a computer simulation of key supply center processes and backlogs that are expected to be impacted by the CIT. The Red Flag Model will enable the four hardware centers to identify potential problem areas 4 to 6 months in advance and take appropriate corrective actions.

The Red Flag Model is so named because measurement of each key process or backlog is accomplished through the use of indicators which track the entire range of operating levels from normal to out of tolerance (i.e., red flag) levels. The red flag indicators were tailored to each supply center by functional area experts who selected the applicable ranges. The key processes or backlogs which are tracked as Red Flag Indicators are:

Supply Operations	Technical Operations
Recommended Buys Processed	Missing Data Work List Balances
Backorder Lines Balances	Purchase Request Referrals
Not Mission Capable Supply (NMCS) Requisitions	

Contracting & Production	Quality Assurance
Purchase Request Lines Balances	Missing Data Work List Balances
Aging of Purchase Request Lines	Purchase Request Referrals

The model's utility is not limited to measuring the impact of the CIT. It can be used to analyze any event or phenomenon which may affect the key processes or backlogs being simulated (e.g., major policy/procedural changes). The Red Flag Model is installed at DLA-DORO and in the Operations Research Office of each DLA hardware center. Current plans call for DLA-DORO to maintain and support the model for a 1-year period. At the end of the first year, the need for continued technical support will be reevaluated.

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SECTION 1
INTRODUCTION

1.1 BACKGROUND

Defense Management Review Decision 926 calls for the transfer of nearly one million consumable items from the military services to the Defense Logistics Agency (DLA) during the period FY91 - FY94. Cataloging activities associated with this transfer of management began 1 January 1991. On 1 August 1991, DLA supply centers began the process of assuming management responsibilities for these items.

For DLA, overall responsibility for the Consumable Item Transfer (CIT) program rests with the Consumable Item Management Office, Directorate of Supply Operations (DLA-OM). Although it was planned that the CIT transfer would be accomplished in 36 monthly increments, DLA-OM was concerned that bottlenecks or choke points would develop at various locations within the DLA supply system as a result of overtaxed resources (i.e., personnel, equipment, etc.). It was believed that these bottlenecks or choke points could be minimized or avoided, if they could be anticipated early enough.

Specifically, DLA-OM desired to have visibility of such potential problem areas from 4-6 months in advance. It was theorized that, in most cases, such advance warning would provide the individual supply centers with sufficient time to take corrective action, such as adding resources or modifying policies and procedures to accomplish larger workloads. However, if major problems were to develop at an individual supply center or if multiple problem areas were to develop at the same time throughout the DLA supply system, then it might become necessary for DLA-OM to alter the flow of items being transferred to DLA.

1.2 PURPOSE AND SCOPE

The purpose of this project was to provide visibility to DLA-OM and the four DLA hardware supply centers of potential problem areas which may develop within the supply centers as a result of the CIT. To meet this purpose a computer simulation model was developed by the DLA Operations Research and Economic Analysis Field Operating Activity (DLA-DORO). The model predicts the effects of the transfer on key processes and backlogs at each of the centers. Measurement of each process and/or backlog is accomplished through the use of red flag indicators which track the entire range of operating levels from normal to out of tolerance (i.e., red flag) levels.
The Defense General Supply Center (DGSC), located at Richmond, Virginia, served as the lead center for the project and the major model development and prototyping was done with the invaluable assistance of DGSC functional area experts. The model was then adapted to the three other hardware centers.

A complete version of the Red Flag Model was delivered to DGSC in March 1992. Complete versions of the model were delivered to the Defense Construction Supply Center (DCSC) and the Defense Electronics Supply Center (DESC) in August 1992. The Defense Industrial Supply Center (DISC) received its complete model in September 1992.

The scope of this project was limited to the development of computer models and associated red flag indicators for the four DLA hardware supply centers. It was believed that other DLA processes and activities (e.g., cataloging and depot operations) were less likely to experience problems of a magnitude which would jeopardize the success of the CIT program.

SECTION 2
DEVELOPMENT APPROACH

2.1 IDENTIFICATION OF FUNCTIONAL AREA EXPERTISE

At the request of DLA-OM, DGSC agreed to serve as the lead or primary center for this project. Accordingly, a primary DGSC Point of Contact (POC) from the Office of Planning and Resource Management (DGSC-R) was designated. In addition, POCs were identified for the DGSC Directorates of Supply Operations (DGSC-O), Contracting and Production (DGSC-P), Technical Operations (DGSC-S), and Quality Assurance (DGSC-Q). A kickoff meeting was held on 24 May 1991, at which time the DGSC POCs agreed to participate in the development of the red flag indicators and computer simulation model. Additionally, the project analysts briefed the Directors of DGSC-O, P, S and Q, on 4 June 1991, to solidify support for the project.

2.2 DETERMINATION OF RED FLAG INDICATORS

From June through August 1991, the DGSC functional area POCs served as a working group for this project. The POCs identified key supply center processes and potential red flag indicators for their respective functional areas. They also assisted in the evaluation of each candidate process or indicator by providing statistical data and other information.

2.2.1 CRITERIA FOR SELECTION OF INDICATORS

In general, the selection of key processes and red flag indicators for inclusion in the simulation model was predicated on the following criteria:

- The process or backlog was expected to be significantly affected by the CIT.
- A basis for predicting the behavior of the process or backlog existed (e.g., historical data).

2.2.2 DLA-OM INVOLVEMENT IN SELECTION OF INDICATORS

After an initial set of red flag indicators was developed, a meeting was held at DGSC in early July 1991 to review the results with DLA-OM and to provide them with an opportunity to meet with the DGSC POCs. A flow chart of the key processes to be simulated was reviewed and the rationale for choosing specific red flag indicators was discussed. Based on DLA-OM's input, the initial set of indicators was modified and briefed at an August 1991 CIT planning conference.

2.2.3 SUPPLY CENTER INPUT IN SELECTION OF INDICATORS

Based on the interest this presentation sparked during the meeting, it became apparent that we needed input from the three other hardware centers at this juncture. This would allow us to confirm and/or modify our efforts to date and ensure a smoother transition of the model from DGSC to the other centers. Accordingly, a meeting was held at DGSC in early September 1991 for that purpose. In addition to the client, the project analysts and the DGSC POCs, the meeting was attended by 19 people from DCSC, DESC and DISC representing their respective directorates/offices of Supply Operations, Contracting and Production, Technical Operations, Quality Assurance and Operations Research. The outcome of this 2-day meeting was a general agreement that the existing red flag indicators which had been identified by DGSC were acceptable to the other hardware centers. However, the project analysts were asked to explore the feasibility of adding certain indicators in the two areas of Supply Operations and Technical Operations.

2.2.4 APPROVED RED FLAG INDICATORS

Our evaluation of additional candidate indicators was completed in October 1991 and the final set of indicators was approved by DLA-OM in November 1991. The approved red flag indicators are as follows:

- For Supply Operations
  - Recommended Buys Processed
  - On Hand Balance (OHB) of Backorder Lines
  - Not Mission Capable Supply (NMCS) Requisitions Processed
- For Technical Operations
  - OHB of Missing Data Work Lists (MDWLs)
  - OHB of Purchase Request (PR) Referrals
- For Quality Assurance
  - OHB of MDWLs
  - OHB of PR Referrals
- For Contracting and Production
  - OHB of PR Lines
  - Aging of PR Lines

2.2.5 OTHER PERFORMANCE INDICATORS

In addition to depicting the various red flag indicators listed in the preceding paragraph, the Red Flag Model simulates supply center personnel performing various key tasks. The utilization of these personnel is tracked throughout the simulation and these statistics can be displayed through the use of animation. Specifically, the model simulates inventory managers in Supply Operations performing manual reviews of recommended buys (RBs) and manual processing of requisitions. The model simulates the manual processing of MDWLs and PR Referrals in both Technical Operations and Quality Assurance. Finally, the model simulates buyers in Contracting and Production processing both large and small PRs. This part of the model development required considerable time and effort in compiling an information base which accurately described the key supply center processes and activities which were most likely to be affected by the CIT program.

2.3 DEVELOPMENT OF BASELINE DATA AND INFORMATION

At the request of the project analysts, all four hardware centers provided a minimum of 2 fiscal years (FY90 and FY91) of workload statistics, including the following data items:

- RBs Processed
- RBs Approved or Modified
- Total Requisitions Processed
- Manual Requisitions Processed
- NMCS Requisitions Processed
- OHB of Backorder Lines
- Direct Vendor Deliveries (DVDs) Processed
- Tech Ops MDWLS Received and Processed
- Quality MDWLs Received and Processed
- Tech Ops PR Referrals Received and Processed
- Quality PR Referrals Received and Processed
- OHB of PR Lines
- PR Lines in Suspense
- PRs Cancelled
- PR Lines Cancelled
- PRs Awarded
- PR Lines Awarded
- Contracts Awarded

In addition, the project analysts collected and analyzed data which allowed the Red Flag Model to depict the aging of on-hand balances such as backorders, MDWLs, PR Referrals and PR Lines. Statistics were also gathered and analyzed which enabled the model to assign dollar values to RBs and DVDs. As the project has progressed, the four supply centers have updated this information with FY92 workload data.

2.4 DEVELOPMENT OF CIT DATA AND INFORMATION

The Red Flag Model treats CIT and baseline (pre-CIT) items separately so that the impacts of the transfer can be demonstrated. Accordingly, a critical requirement of this project was the availability of information describing the characteristics of items being transferred to DLA, to enable comparison to the baseline DLA-managed items.

2.4.1 CIT DATA BASE

A CIT data base is being maintained within the DLA Integrated Data Bank (DIDB) on items which have been transferred as well as items which are within a few months of being transferred. The pre-transfer information is provided by the military supply center which is the Losing Item Manager (LIM) to the DLA supply center which is the Gaining Item Manager (GIM). To date, the pre-transfer information has been particularly useful from a forecasting standpoint since it has provided some insight concerning the nature of future supply center activity. In particular, our forecasts of future workloads have relied heavily on the LIM's information concerning the demand experience of each item and its current asset position.

2.4.2 ASSUMPTIONS REGARDING CIT ITEM BEHAVIOR

Obviously, as the transfer proceeds, the post-transfer performance (e.g., demand frequency) of these new items will be a larger factor in developing workload forecasts. However, very little tracking of CIT-generated workloads is being done by DLA supply centers. With the exception of Supply Operations data, available from the F67A (Supply Availability and Workload Analysis Report (Grand Total-CIT)) reports at all four hardware centers, almost no quantitative information about the behavior of CIT items is available. As a consequence, it has been necessary in almost every case to assume that CIT items behave exactly like baseline items as far as workloads like MDWLS and PR Referrals are concerned. This applies to both Technical Operations and Quality Assurance although DGSC-S is tracking some CIT workloads. Similar assumptions have also been required for certain key relationships which are inputs to the Contracting and Production portion of the model (e.g., lines per PR, percent of PRs cancelled).

2.5 FORECASTING METHODOLOGIES

Since the Red Flag Model is designed to predict workload-related problems from 4-6 months in advance, it was necessary to develop methodologies for forecasting certain workloads. There are two basic forecasts which must be made: RBs processed per month and total requisitions processed per month. Both of these forecasts are external to the model.

2.5.1 FORECASTING RECOMMENDED BUYS

The RB forecast is developed and/or updated quarterly using the most current data available from the DIDB. The forecast uses the demand history and asset position of the items managed by each supply center. Only active items (i.e., those having an annual demand frequency greater than zero) are considered in the forecast computation. The active items are stratified into seven categories based on the dollar value of their Economic Order Quantities (EOQ).

RB factors have been developed to estimate the number of RBs each grouping of active items will generate. Essentially, these factors represent the percentage of items in each EOQ category which are at or near their reorder points. Thus, the forecast of RBs to be generated is obtained by multiplying the number of active items in each EOQ category by the applicable RB factor, and then summing the results across all EOQ categories. The result of this computation is an estimate of the <u>average</u> number of RBs to be processed per month. The total number of RBs to be processed in the 6 month forecast period is computed by multiplying the average by six. The estimate of total RBs is then distributed among the 6 months of the forecast using historical percentages.

2.5.2 FORECASTING REQUISITIONS

The methodology employed for forecasting total requisitions uses past experience to predict future performance. Specifically, this methodology uses 6 months of historical requisition counts to forecast up to 6 months into the future. Based on an analysis of monthly requisition counts reported by each supply center, ratios have been developed which quantify the historical relationships between each 6-month period and the next 3-6 month period.

Using DGSC as an example, we compute a monthly average for any given 6-month period and then multiply that average by a ratio that ranges between 0.9476 and 1.0879, depending on the forecast period. This provides an average monthly forecast which can be converted to a quarterly or semiannual forecast by multiplying by three or six. The estimate of total requisitions can be apportioned among the actual months covered by the forecast using historical percentages.

Once the total requisition forecast has been developed, other forecasts are computed as percentages of the total requisition forecast. For example, for DGSC baseline items, manual requisitions are computed as 16.0 percent of the total requisitions forecasted; DVDs are estimated at 2.0 percent of total requisitions; and the forecast of backorders established is computed as approximately 18 percent of total requisitions.

2.6 DEVELOPMENT OF A BASELINE SIMULATION MODEL

Early on in this project, the client and the project analysts agreed that the Red Flag Simulation Model should be developed as a personal computer (PC) application. This decision was made because it was believed that a PC application would be easier to export from DGSC to the other hardware centers and easier to use by supply center personnel. In addition, a PC application would allow the user to actually "see" the simulation through the use of animation. At the time the project was initiated, however, the necessary PC software and hardware was not available to the project analysts. Therefore, initial development work was accomplished on the DORO mainframe computer using the SLAM II simulation software package.

2.6.1 SLAMSYSTEM EMPLOYED

With the assistance of DGSC, the PC simulation software (SLAMSYSTEM) was purchased and arrived in early October, 1991. DGSC actually purchased six copies of the software, one copy each for: DGSC, DORO, DLA-OM, DESC, DCSC, and DISC. The PC hardware needed to run SLAMSYSTEM arrived in early November and by mid-November, the project analysts had successfully transferred the mainframe computer model to a PC application using SLAMSYSTEM. Since then, all model development has been accomplished with the PC application.

2.6.2 A FINAL BASELINE VERSION

By January 1992, a "baseline" version of the Red Flag Model had been developed. The baseline model simulated existing key processes and backlog queues at DGSC excluding any CIT-generated workloads. Development of the baseline model allowed for validation of model logic by comparing model results to actual historical workload data. Only when it was determined that the model could accurately simulate an historical period could it then be expanded and enhanced to simulate a forecast period which included workloads generated by CIT items.

2.7 DEVELOPMENT OF THE CIT-ENHANCED RED FLAG MODEL

Once the project analysts were satisfied that the baseline model was capable of accurately simulating a pre-CIT environment, efforts shifted to expanding and enhancing the model to simulate the effects of the CIT on key processes and backlogs at the primary center. This necessitated the development of forecasts of CIT-generated workloads such as RBs and manual requisitions. However, it also meant that the model must be able to distinguish workloads generated by CIT items from baseline workloads. This feature is especially critical if the model is used to perform "what if" analyses. Accordingly, it was at this point in the Red Flag Model's development that a user interface was created.

The user interface, which is discussed in more detail in Section 3.2, is a LOTUS spreadsheet file containing all of the data inputs to the model. Separate parts of the spreadsheet are provided for CIT and non-CIT inputs. The user has the option of accepting the default input values provided by DORO or making changes to any or all of these values. The user can even choose to run the model with no CIT input values at all.

As previously noted, the CIT-enhanced version of the Red Flag Model was delivered to DGSC in March 1992. Prototype versions of the model were delivered to DCSC, DESC and DISC in April 1992 and complete versions were installed at these three supply centers during the last week of August, 1992 and the first week of September, 1992.

SECTION 3
RESULTS

3.1 DESCRIPTION OF THE RED FLAG MODEL

The Red Flag Model is a PC based simulation application. It was developed with the SLAMSYSTEM simulation software package. Although most model builders will find SLAMSYSTEM to be a user-friendly simulation package, it does require extensive use of the PC resources. Specific resource requirements are addressed in Section 3.7 of this report.

3.1.1 ANIMATION

The Red Flag Model can be run with or without animation. Statistical and graphical output reports can be produced in either mode. The advantage of animation is that the user can visually display the simulation results. In other words, the user can view each red flag indicator as its status potentially changes from green (normal) to yellow (above normal) to red (out of tolerance) during the course of the simulation. The animation screens also dynamically display the ongoing utilization levels of selected supply center personnel as simulated tasks are performed (e.g., manual reviews of RBs by inventory managers).

The disadvantage of animation is the length of time required to run the model. While a non-animation version of the model will require approximately 1 hour to simulate a 6-month period of time (on an 80386 DX computer), an animated version will require 4 - 6 hours for the same 6-month period, depending on the supply center being simulated. It is for that reason that the user will rarely wish to run the simulation and view the animation concurrently. Instead, SLAMSYSTEM allows the user to capture the animation and view it later, much like a television video replay. A 6-months animation replay takes only 10 - 15 minutes to run. This feature makes it very practical to run the model overnight and view the animation the following day. Of course, the user may not always need to run a 6-month simulation. Accordingly, the model can be used to simulate any length of time between 1 day and 6 months.

3.1.2 SCENARIOS

For any given hardware center, there are actually five separate versions or "scenarios" of the Red Flag Model. The "BASECASE" scenario allows the user to run the model without animation. As noted previously, this is the quickest and best way to run the model if the user is primarily interested in the model's statistical output. The other four scenarios are "SUPPLY," "TECHOPS," "QUALITY" and "PURCHASE." They are provided for animation purposes and each scenario corresponds to one of the four supply center directorates being simulated.

The need for multiple animation scenarios stems from a constraint of the simulation software being used. In the MS DOS version of SLAMSYSTEM, only two animation screens are available per scenario. Accordingly, each animation scenario of the Red Flag Model provides a "systems overview" screen which displays all four directorates at once and a "blowup" screen which displays, in more detail, either the Supply Operations, Technical Operations, Quality Assurance or Contracting and Production animation. In viewing the animation, the user may "toggle" back and forth between the "systems overview" screen and the "blowup" screen.

3.2 THE RED FLAG MODEL USER INTERFACE

The Red Flag Model user interface is a LOTUS spreadsheet file containing all of the data inputs to the model. The format of the spreadsheet is shown at Appendix A. The spreadsheet provides for separate CIT and non-CIT inputs. For example, the user may input separate CIT and non-CIT (baseline) forecasts of RBs, manual requisitions, DVDs, backorders and NMCS requisitions. If desired, the user may choose not to enter any CIT workload forecasts. However, the user must always provide baseline forecast data. Other inputs to the model which are contained in the spreadsheet include beginning on-hand balances (e.g., backorders, PR lines), number of personnel (e.g., inventory managers, buyers), and processing times.

It is planned that DORO will periodically update this spreadsheet file with new workload forecasts. Other parameter values (e.g., lines per PR, RB approval rate) will also be revised as required. These updates will be considered default values and the spreadsheet containing these default values will be write-protected.

The user may, however, make copies of the default files and then may make changes to the copies. In this way, the user has the option of accepting the default input values provided by DORO or he or she may make changes to any or all of these values in the course of performing "what-if" analyses.

3.3 ACCURACY OF KEY WORKLOAD FORECASTS

The Red Flag Model is a tool which serves a two-fold purpose: (1) it can be used to predict workload problems before they occur, and (2) it can perform "what if" analyses aimed at finding solutions to these anticipated problems. The degree to which the model is able to predict problems in advance of their occurrence is largely a function of the accuracy of key workload forecasts which are inputs to the model.

At the time this report was written, an evaluation of forecasting accuracy could only be made for the primary center, DGSC. Sufficient data was not available to make similar evaluations for

DCSC, DESC and DISC. As the transfer progresses and more data is obtained, this kind of evaluation will be performed for all four hardware centers.

When the complete Red Flag Model was first delivered to DGSC, the default input file created by DORO provided monthly workload forecasts for the 6-month period January - June 1992. Table 3-1 provides a comparison of the total workload forecast versus the actual workload experienced by DGSC. Table 3-2 provides a comparison of the CIT workload forecasts versus the actual CIT workload experienced. A month-by-month breakdown of these forecasts is provided at Appendix B.

Table 3-1. Summary of the First 6 Months of DGSC Red Flag Model Forecasts (Jan - Jun 92)

	WORK PROCESSED	FORECAST	ACTUAL	PERCENT DIFFERENCE
1.	RBs Processed	75,320	64,157	17.4%
2.	RBs Approved	24,855	21,721	14.4%
3.	Total Reqs Proc'd	1,544,873	1,422,072	8.6%
4.	Manual Reqs Proc'd	245,992	224,409	9.6%
5.	DVDs Processed	31,036	34,914	-11.1%
6.	NMCS Processed	33,750	37,679	-10.4%

Table 3-2. Summary of the First 6 Months of DGSC Red Flag Model Forecasts - CIT Generated Workload Only (Jan - Jun 92)

	WORK PROCESSED (*)	FORECAST	ACTUAL	PERCENT DIFFERENCE
1.	RBs Processed	5,255	6,571	-20.0%
2.	RBs Approved	2,809	NA	NA
3.	Total Reqs Proc'd	93,811	84,581	10.9%
4.	Manual Reqs Proc'd	6,566	5,889	11.5%
5.	DVDs Processed	563	363	55.1%
6.	NMCS Processed	1,241	1,100	12.9%

(*) a. RBs processed are for Mar - Jun 92 (4 months)
b. Data not available for CIT RBs approved
c. NMCS processed are for Apr - Jun 92 (3 months)

3.3.1 ANALYSIS OF TOTAL WORKLOAD FORECASTS

Table 3-1 shows that the difference between forecasts of key workloads and actual workloads ranged from 17.4 percent high (for RBs processed) to 11.1 percent low (for DVDs processed). For first-time forecasts, these levels of accuracy seem reasonable. Even more encouraging is the fact that the forecast of total requisitions processed was within 8.6 percent of the actual workload. Although the total requisition forecast is not a direct input to the Red Flag Model, it is the first step in the development of forecasts for manual requisitions, DVDs and NMCS requisitions which are direct inputs to the model.

3.3.2 ANALYSIS OF CIT-GENERATED WORKLOAD FORECASTS

Table 3-2 shows that the forecasts of key CIT-generated workloads ranged from 55.1 percent high (for DVDs processed) to 20.0 percent low (for RBs processed), when compared to actual CIT-generated workloads. However, the forecasts of other CIT workloads were within 11-13 percent of actual counts. These comparisons not only provide a measure of model accuracy, but also illustrate the fact that, early in the transfer, the CIT portion of total workload was relatively small. Given this ratio of CIT workload to total workload, these forecasts were within acceptable levels of tolerance. However, as the CIT workload becomes a larger and larger portion of the total, improved forecasting accuracy will be essential. Early CIT workload forecasting has been hampered by the lack of data. As the transfer progresses and more data becomes available, better forecasts will be possible.

3.4 INTERPRETATION OF RED FLAG MODEL SIMULATION RESULTS

The Red Flag Model employs statistical probability distributions at numerous points in the simulation to determine and assign such attributes as the length of time a PR line will age or the dollar value of an RB. These statistical distributions are developed from actual historical data and their use enables the model to more accurately emulate the peaks and valleys which occur in the "real world". If, for example, 50 percent of all PR lines actually age for 60 days or less, then a PR line created by the Red Flag Model will have a 50 percent chance of aging for 60 days or less. While this approach makes the model more realistic, it also injects a degree of randomness into the model results. Consequently, given the same input values, no two model runs will produce identical results. To avoid misinterpretation of simulation results and to observe and evaluate the variability of the model's output, multiple replications are recommended. Accordingly, an output report writer has been developed for the Red Flag Model which automatically computes average results across all replications (for replications > 1) and provides an analysis of the variability of those results.

3.5 ACCURACY OF THE RED FLAG MODEL SIMULATION RESULTS

The Red Flag Model is a computer simulation of key supply center processes and outcomes. The processes are measured and tracked in terms of personnel utilization. The outcomes are quantified and depicted in terms of absolute on-hand balances and the degree to which these balances rise to above-normal or out-of-tolerance (red flag) areas. Obviously, the accuracy of workload forecasts and other input data will play a large part in determining the accuracy of model results. However, given that these inputs to the model are realistic, the question then becomes how accurately does the model emulate these key supply center processes and outcomes?

3.5.1 PERSONNEL UTILIZATION

Through August 1992, the Red Flag Model predicted no significant personnel utilization problems at the four hardware supply centers. This appears to be consistent with actual supply center experience during this time period. The model does indicate that perhaps there is not a large capacity to absorb additional workload growth. The model computes personnel utilization averages between 85-95 percent across all four hardware centers. Additionally, the model indicates that there is insufficient time available in certain areas for various lower priority tasks to be accomplished due to the press of higher priority workloads such as RBs and manual requisitions in Supply Operations and MDWLs and PR Referrals in Technical Operations. It should be noted, therefore, that at least one DLA hardware center has requested authorization from the DLA Comptroller to hire additional personnel in the Technical Operations area.

3.5.2 ON-HAND BALANCES

To date, with the exception of backorders, the Red Flag Model has predicted no significant increases in on-hand balances at the four hardware centers. The model predicted that backorders would steadily increase at all four centers. In reality, during the period October 1991 through April 1992, backorders increased by 20 percent at both DCSC and DESC. Backorders for both of these supply centers have been in a red flag area since February 1992. From October 1991 through June 1992, backorders at DGSC increased by nearly 11 percent. In fact, DGSC backorders have been at red flag levels for all of FY92. DISC backorder levels remained virtually unchanged during this same time period.

The CIT most certainly has played a part in the backorder increases described above, although money constraints are another large factor. Many of the backorders on CIT items were not established by DLA but were passed to DLA by the services' LIMs. More than 36,000 such "passed backorders" were received by the four DLA hardware centers during the period August 1991 through May 1992.

3.6 BENEFITS OF THE RED FLAG MODEL

By providing visibility of potential problems before they occur, it is believed that the Red Flag Model will yield the following benefits:

- Improvement in DLA-OM's ability to assess the impacts of the consumable item transfer and take effective and timely actions to correct problems, as appropriate and feasible.

- Avoidance of costly processing delays and backlogs resulting from increased DLA hardware supply center workloads generated by the consumable item transfer.

- Improvement in the ability of DLA's hardware supply centers to maintain high levels of customer support while absorbing increased workloads with minimal increases in resources.

3.7 MAINTENANCE AND SUPPORT OF THE RED FLAG MODEL

To assist users with day-to-day model operation and to identify specific PC resource requirements, a user's guide has been developed. The Red Flag Model User's Guide is provided at Appendix C. At the request of DLA-OM, it has been agreed that DORO will maintain and support the Red Flag Model under the auspices of project DLA-XX-20278, Technical Support for CIT Red Flag Model. This support will be for a 1-year duration commencing on or about 1 October 1992 and will involve ongoing review and evaluation of model parameters including periodic updates of workload forecasts and other inputs to the model. DORO will run the model on an as needed basis. At the end of the first year, the need for continued technical support will be reevaluated.

SECTION 4
SUMMARY

The objectives of this project have been achieved. A computer simulation model was developed to provide DLA-OM and the four DLA hardware supply centers visibility of potential problem areas which may develop within the supply centers as a result of the CIT. The Red Flag Model is designed to predict the effects of the transfer on key processes and backlogs at each of the centers. Measurement of each process and/or backlog is accomplished through the use of red flag indicators which track the entire range of operating levels from normal to out of tolerance (i.e., red flag) levels.

The selection of key processes and red flag indicators for inclusion in the Red Flag Model was predicated on the following two criteria:

- The process or backlog was expected to be significantly impacted by the CIT.
- A basis for predicting the behavior of the process or backlog existed (e.g., historical data).

The red flag indicators incorporated into the model are as follows:

- <u>For Supply Operations</u>
  - Recommended Buys Processed
  - On Hand Balance (OHB) of Backorder Lines
  - Not Mission Capable Supply (NMCS) Requisitions Processed
- <u>For Technical Operations</u>
  - OHB of Missing Data Work Lists (MDWLs)
  - OHB of Purchase Request (PR) Referrals
- <u>For Quality Assurance</u>
  - OHB of MDWLs
  - OHB of PR Referrals
- <u>For Contracting and Production</u>
  - OHB of PR Lines
  - Aging of PR Lines

The Red Flag Model is a PC based application which was developed with the SLAMSYSTEM simulation software package. The model can be run with or without animation. Statistical and graphical output reports can be produced in either mode. The advantage of

animation is that the user can visually display the simulation results showing each red flag indicator potentially change from green (normal) to yellow (above normal) to red (out of tolerance) during the course of the simulation. The disadvantage of animation is the length of time required to run the model. Fortunately, SLAMSYSTEM allows the user to capture the animation and view it later, much like a television video replay. The model can be used to simulate any length of time between 1 day and 6 months.

A user interface is provided with the Red Flag Model which contains all of the data inputs to the model. The user interface is a LOTUS spreadsheet file which provides separate CIT and non-CIT (baseline) workload forecasts (e.g., RBs, manual requisitions, DVDs, etc.) as well as other inputs to the model such as beginning on-hand balances, number of personnel and processing times. DORO will periodically update this spreadsheet file with new workload forecasts and updates of other parameter values. These updates will be considered default values. The user, however, has the option of accepting the default input values provided by DORO or he or she may make changes to any or all of these values in the course of performing "what-if" analyses.

To date, the Red Flag Model has predicted no significant personnel utilization problems at the four DLA hardware supply centers. This appears to be consistent with actual supply center experience during this time period. The model does indicate, however, that perhaps there is not a large capacity to absorb additional workload growth. With the exception of backorders, the model has predicted no significant increases in on-hand balances at the four centers. The model predicted that backorders would steadily increase at all four centers. In reality, backorders have increased by as much as 20 percent at three of the hardware centers while remaining virtually unchanged at the fourth supply center.

Current plans call for DORO to maintain and support the Red Flag Model for a 1-year period. This support will consist of ongoing review and evaluation of model parameters including periodic updates of workload forecasts and other inputs to the model. At the end of the first year, the need for continued technical support will be reevaluated.

SECTION 5
RECOMMENDATIONS

DLA-OM should pursue the successful implementation of the Red Flag Model at the four DLA hardware supply centers where the model has been installed. To accomplish this successfully, we recommend DLA-OM do the following:

- **Establish an Implementation Working Group (IWG).** The main purpose of the IWG will be to promote the use of the Red Flag Model and insure the accurate interpretation of model results. The IWG should consist of at least two representatives from each of the four DLA hardware supply centers, one representative from DLA-OM and one representative from DORO.

- **Convene the IWG at least quarterly.** The IWG should periodically examine model results and compare forecasted workload to actual experience. Minutes of these meetings should be shared with high level management at each of the hardware supply centers.

- **Survey the four Hardware Centers**, at least semiannually. DLA-OM should periodically determine who is using the Red Flag Model and how it is being applied. Survey results should be shared with the IWG.

APPENDIX A

FORMAT OF THE RED FLAG MODEL USER INTERFACE

APPENDIX A
FORMAT OF THE RED FLAG MODEL USER INTERFACE

CIT MODEL
SIMULATION INPUT
FOR JAN - JUN 92
DGSC
SUPPLY OPERATIONS

*** WORKLOAD DATA ***

FORECAST FOR:	MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6
* NON-CIT GENERATED:						
RECOMMENDED BUYS....	11598	13948	11661	12913	9305	7384
MANUAL REQS.....	40297	41674	45199	40389	37301	34565
DIRECT VENDOR DELS..	5129	5304	5753	5140	4747	4399
BACKORDERS ESTAB....	41518	42937	46569	41613	38431	35613
NON-MISS-CAP-SUP....	5411	5326	6070	5425	5011	4644

FORECAST FOR:	MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6
* CIT GENERATED:						
RECOMMENDED BUYS....	1479	1777	1488	1641	1182	944
MANUAL REQS.....	715	836	1038	1257	1335	1385
DIRECT VENDOR DELS..	61	72	89	108	114	119
BACKORDERS ESTAB....	3883	4539	5633	6826	7248	7519
NON-MISS-CAP-SUP....	225	263	326	395	419	435

BO BEGINNING OHB....	147888		
RB APPROVAL RATE (%)	0.33		
MINIMUM RB $ VAL....	50.0		
MINIMUM DVD $ VAL...	50.0		
AUTO RB $ VAL MIN...	1500.0	AUTO RB %	25.0%

	NON-CIT	CIT
DVD % NSN VS PN.....	0.645	1.000

*** PERSONNEL DATA ***

NUMBER OF PERSONNEL	111.0
LEAVE %	0.165
OTHER DUTY %	0.400

SUPPLY OPERATIONS (Continued)

*** TASK PERFORMANCE TIMES ***

TIME (MIN) TO PROCESS	NON-CIT	CIT
RECOMMENDED BUY.....	22.2	22.2
MANUAL REQUISITION...	6.8	6.8

TECHNICAL OPERATIONS

*** WORKLOAD DATA ***

	NON-CIT	CIT
% 353 EXPECTED.....	0.088	0.088
% MDWL EXPECTED....	0.190	0.400
353 BEGINNING OHB...	611	
MDWL BEGINNING OHB..	1039	

*** PERSONNEL DATA ***

NUMBER OF PERSONNEL	55.0
LEAVE %	0.192
OTHER DUTY %	0.400

*** TASK PERFORMANCE TIMES ***

TIME (MIN) TO PROCESS	NON-CIT	CIT
353	75.4	75.4
MDWL	44.5	44.5

APPENDIX A (Continued)

QUALITY ASSURANCE

*** WORKLOAD DATA ***

	NON-CIT	CIT
% 353 EXPECTED.....	0.014	0.014
% MDWL EXPECTED....	0.087	0.150
353 BEGINNING OHB...	27	
MDWL BEGINNING OHB..	17	

*** PERSONNEL DATA ***

NUMBER OF PERSONNEL	35.0
LEAVE %	0.189
OTHER PRE DUTY % ...	0.180
OTHER POST DUTY % ..	0.700

*** TASK PERFORMANCE TIMES ***

TIME (MIN) TO PROCESS	NON-CIT	CIT
353	17.4	17.4
MDWL	17.4	17.4

APPENDIX A (Continued)

CONTRACTING AND PRODUCTION

*** WORKLOAD DATA ***

PR $ VAL BEGIN'G OHB	277.2	IN 100 MILLIONS
PR LINE BEGIN'G OHB.	35349	

	NON-CIT	CIT
% PRS CANCELLED....	0.246	0.246
LINES PER LARGE PR	4.0	4.0
LINES PER SMALL PR	1.5	1.5

*** PERSONNEL DATA ***

# OF PERSONNEL (LARGE)	61.0
# OF PERSONNEL (SMALL)	125.0
LEAVE % (LARGE).....	0.199
LEAVE % (SMALL).....	0.199

*** TASK PERFORMANCE TIMES ***

TIME (MIN) TO PROCESS	NON-CIT	CIT
LARGE PURCHASE LINE..	342.9	342.9
SMALL PURCHASE LINE..	81.8	81.8

APPENDIX B

MONTH-BY-MONTH BREAKDOWN OF DGSC WORKLOAD FORECASTS VS ACTUAL WORKCOUNTS FOR JAN - JUN 1992

APPENDIX B

DGSC WORKLOAD FORECASTS
vs ACTUAL WORKCOUNTS
FOR JAN - JUNE 1992
FOR ALL NSNS (CIT AND NON CIT)

MONTH	ESTIMATED RBS PROCESSED	ACTUAL RBS PROCESSED	EST RBS APPROVED OR MODIFIED	ACTUAL RBS APPROVED OR MODIFIED	ESTIMATED TOTAL REQS PROC'D	ACTUAL TOTAL REQS PROC'D
FY 92 JAN	13077	11925	4315	4065	254442	234558
FEB	15725	7493	5189	3352	264514	240505
MAR	13149	14572	4339	3871	288759	252547
APR	14554	12949	4803	6314	262746	250497
MAY	10487	8798	3461	853	245139	230715
JUN	8328	8420	2748	3266	229273	213250
TOTALS	75320	64157	24855	21721	1544873	1422072
AVERAGES	12553	10693	4143	3620	257479	237012

APPENDIX B (Continued)

DGSC WORKLOAD FORECASTS
vs ACTUAL WORKCOUNTS
FOR JAN - JUNE 1992
FOR ALL NSNS (CIT AND NON CIT)

MONTH	ESTIMATED MANUAL REQS PROC'D	ACTUAL MANUAL REQS PROC'D	ESTIMATED NMCS REQS PROC'D	ACTUAL NMCS REQS PROC'D	ESTIMATED DVDS PROC'D	ACTUAL DVDS PROC'D
FY 92 JAN	41012	38689	5436	5586	5190	4982
FEB	42510	38600	5589	5828	5376	5204
MAR	46237	40017	6396	6468	5842	5864
APR	41647	38462	5820	6416	5248	6551
MAY	38636	35286	5430	6824	4862	5746
JUN	35950	33355	5079	6557	4518	6567
TOTALS	245992	224409	33750	37679	31036	34914
AVERAGES	40999	37402	5625	6280	5173	5819

APPENDIX B (Continued)

DGSC WORKLOAD FORECASTS
vs ACTUAL WORKCOUNTS
FOR JAN - JUNE 1992
FOR CIT NSNS ONLY

MONTH	ESTIMATED RBS PROCESSED	ACTUAL RBS PROCESSED	EST RBS APPROVED OR MODIFIED	ACTUAL RBS APPROVED OR MODIFIED	ESTIMATED TOTAL REQS PROC'D	ACTUAL TOTAL REQS PROC'D
'Y 92 JAN	1479	N/A	488	N/A	10218	9725
FEB	1777	N/A	586	N/A	11946	11320
MAR	1488	1942	491	N/A	14824	13806
APR	1641	1825	542	N/A	17963	18360
MAY	1182	1416	390	N/A	19073	15425
JUN	944	1388	312	N/A	19787	15945
TOTALS	8511	6571	2809	0	93811	84581
MAR - JUN	5255	6571				
AVERAGES	1419	1643	468		15635	14097

APPENDIX B (Continued)

DGSC WORKLOAD FORECASTS
vs ACTUAL WORKCOUNTS
FOR JAN - JUNE 1992
FOR CIT NSNS ONLY

	ESTIMATED MANUAL REQS PROC'D	ACTUAL MANUAL REQS PROC'D	ESTIMATED NMCS REQS PROC'D	ACTUAL NMCS REQS PROC'D	ESTIMATED DVDS PROC'D	ACTUAL DVDS PROC'D
Y 92 JAN	715	753	223	N/A	61	68
FEB	836	949	261	N/A	72	59
MAR	1038	1080	324	N/A	89	51
APR	1257	1184	392	348	108	52
MAY	1335	869	417	380	114	64
JUN	1385	1054	432	372	119	69
TOTALS	6566	5889	2049	1100	563	363
APR - JUN			1241	1100		
AVERAGES	1094	982	342	367	94	61

APPENDIX C

USER'S GUIDE

RED FLAG MODEL

OCTOBER 1992

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SECTION 1
MODEL OVERVIEW

The "Red Flag" model is a PC based simulation using the SLAMSYSTEM simulation package. The model simulates (with the option to animate) up to 6 months of the Construction, Electronics, General, or Industrial Supply Center's operations. Specifically modeled are tasks in the Supply, Technical Operations, Quality Assurance, and Contracting and Production directorates which have been identified as those most likely to be affected by the Consumable Item Transfer (CIT). Additionally, a 6 month forecast of workload (e.g., manual requisitions to be processed, etc.), will be updated and provided by DLA-DORO quarterly. Finally, all model input may be modified by the user to evaluate the effect/sensitivity of such changes on the system.

SECTION 2
GETTING STARTED

Although SLAMSYSTEM is a user-friendly simulation package, it requires extensive use of the PC resources.

2.1 PC SETUP

SLAMSYSTEM is best run on at least a 25 Megahertz, 386 based PC with 4 Megabytes of RAM. The MS-DOS 5.0 operating system and Windows 3.x graphical environment must also be used. LOTUS 3.0 is required to modify input data via the input data preprocessor. The requirement for a 386 based PC is based on SLAMSYSTEM's requirement of 590K or greater of conventional memory to perform its functions. With the 386 architecture and MS-DOS 5.0's commands, such as DOS=HIGH and DEVICEHIGH "devicename" used in the system file CONFIG.SYS and the command LOADHIGH "file" used in the AUTOEXEC.BAT file , the bulk of the operating system can be loaded into "upper" memory. This frees the 590K or more of conventional memory required by SLAMSYSTEM.

2.2 BATCH FILE / MENU SELECTION

SLAMSYSTEM can be invoked by executing the batch file (i.e., REDFLAG.BAT) or the center specific menu option provided during installation of the model. In addition to setting system resources as stated above in 2.1, this file will invoke Windows, SLAMSYSTEM, and will set SLAMSYSTEM's system variables (i.e., SET SLAMROOT = C:\SLAMDOS\PROJDOS) if they have not been previously set. Finally, this batch file sets the system's B: drive to a RAM drive (created in CONFIG.SYS) so that the model may write/read files more efficiently. Upon executing this batch file, the SLAMSYSTEM Main Menu (see Figure 2-1) is provided.

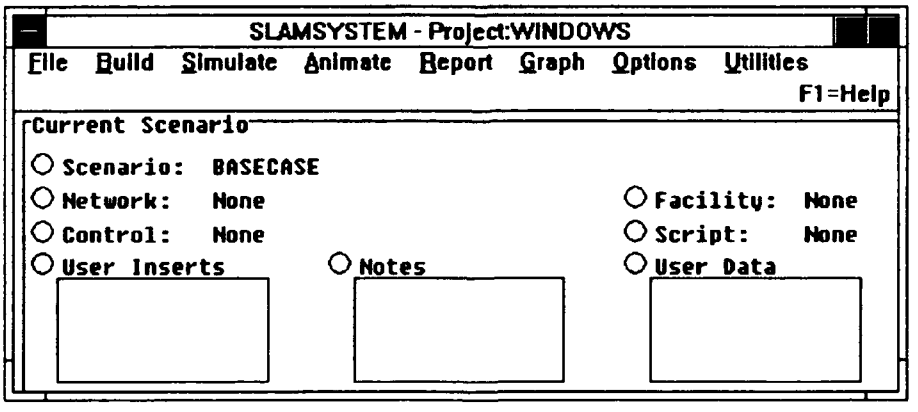

Figure 2-1. SLAMSYSTEM Main Menu

SECTION 3
MODEL SELECTION AND PARAMETERS

The SLAMSYSTEM Main Menu is used to select the model to run and to specify parameters which define how that model will run. In this user's guide, bold text represents words as they are seen on the SLAMSYSTEM menus. To "select" an option, point and left-button click the mouse on the boldface word as indicated. To highlight a value or option, point and left-button click the mouse on the value or in the corresponding box of the desired option.

3.1 OPENING A FILE

Upon selecting **File**, then **OPEN**, as shown in Figure 3-1, a list of Projects (or models) is provided (see Figure 3-2). Selecting **REDFLAGG** (for REDFLAG DGSC), then **OPEN**, opens the REDFLAG project/model for DGSC as shown in Figure 3-3. The scenario in use when the model REDFLAGG was last saved will be current. When a new File, Scenario, etc., is selected, SLAMSYSTEM will ask if the current File, Scenario, etc., should be saved. Select **Yes** to save any changes; **No** to quit without saving changes.

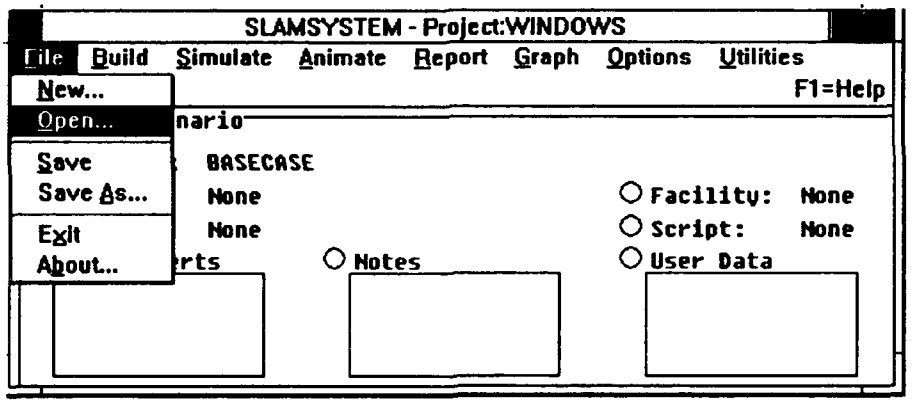

Figure 3-1. File Open Menu

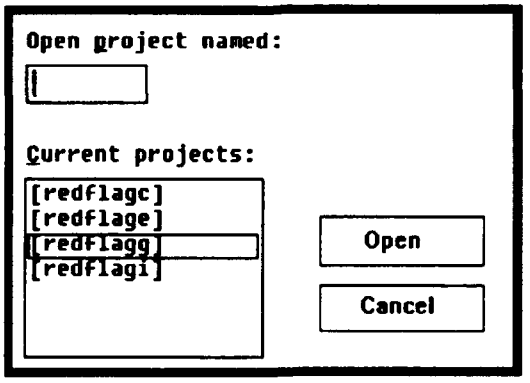

Figure 3-2. Project (File) Selection Menu

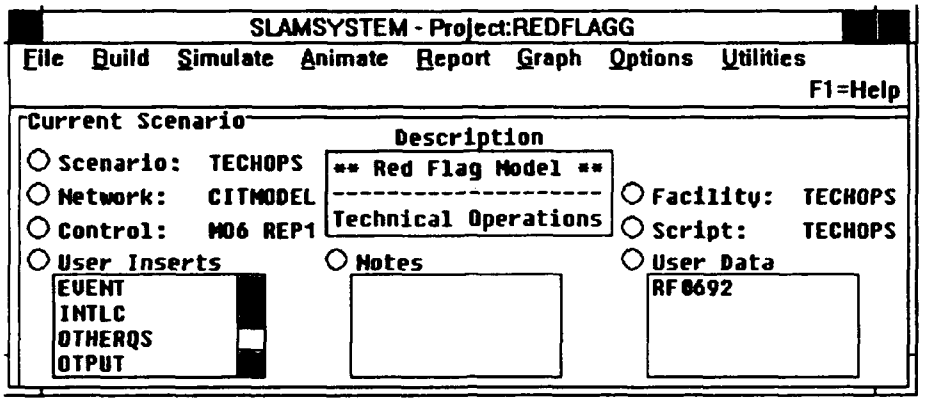

Figure 3-3. Sample Project

3.2 CHOOSING A SCENARIO

To change scenario, select **SCENARIO:** from Figure 3-3. This brings up the Scenario Selection Menu (see Figure 3-4). The current scenario is shown. To change to the Supply Directorate scenario, select **SUPPLY**, then **OPEN**.

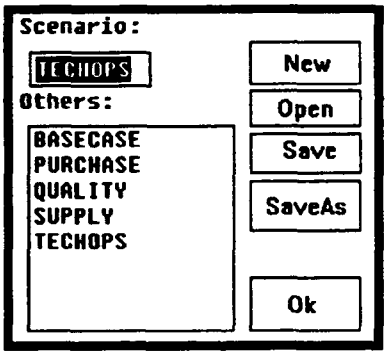

Figure 3-4. Scenario Selection Menu

3.3 CHOOSING A CONTROL FILE

The control file is used to specify the number of replications and the "run time" or simulation duration (discussed later). To choose a control file, select **Control:** from Figure 3-3. This brings up the Control File Selection Menu (see Figure 3-5). To change to the MO6_REP5 control file, select **MO6_REP5**, then **SET CURRENT**, then **OK**. The installation of the model included, as a minimum, two control files, MO6_REP1.CON and MO6_REP5.CON. The nomenclature used in these control file names is interpreted as follows; MO6 dictates that the model will run for 6 simulated months (MO1 represents 1 simulated month) and REP1 dictates that only one replication of this 6 month simulation will be run (REP5 represents 5 replications). Multiple replications are generated to observe/evaluate the variability of a stochastic model's output.

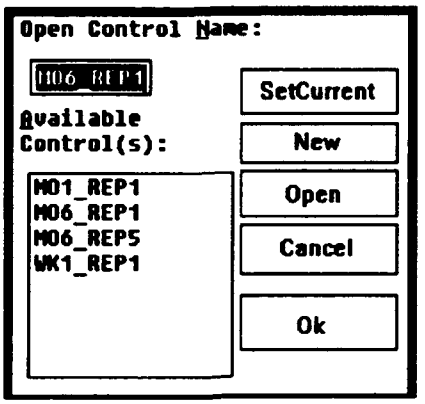

Figure 3-5. Control File Selection Menu

3.4 SPECIFYING NUMBER OF REPLICATIONS AND "RUN TIME"

In order to specify the number of replications and the "run time", the control file must be modified. This is done by bringing up the Control File Selection Menu (see Figure 3-5) as explained above in 3.3. To modify the MO6_REP1 control file, select **MO6_REP1**,then **SET CURRENT**, then **OPEN**. This will bring up SLAMSYSTEM's Control Builder with the file MO6_REP1 open (see Figure 3-6).

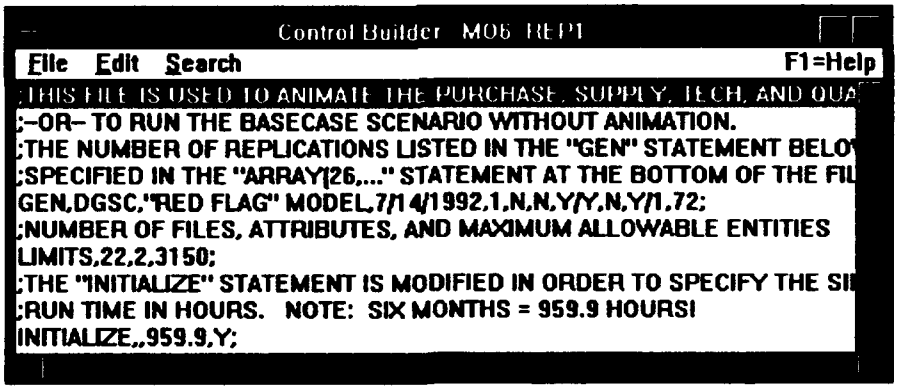

Figure 3-6. GEN and INITIALIZE Statements

3.4.1 NUMBER OF REPLICATIONS

The "GEN..." and "ARRAY(26,1)..." statements must be modified in order to specify the number of replications desired. Double-clicking the left mouse button on the GEN statement will bring up the GEN definition box (see Figure 3-7). The number of replications is specified by highlighting the "Number of runs:" box. Enter the new value, then select **OK**. To change the "ARRAY(26,1)..." statement, scroll to the bottom of the file (see Figure 3-8) and double click the left mouse button on the line "ARRAY(26,1)...". This will bring up the Array definition box (see Figure 3-9). Set the number of replications equal to the "Number of runs" specified in the GEN statement by highlighting the "Initial Values:" box. Enter the appropriate number of replications, select **Change entry**, then

OK. The new number of replications has now been set.

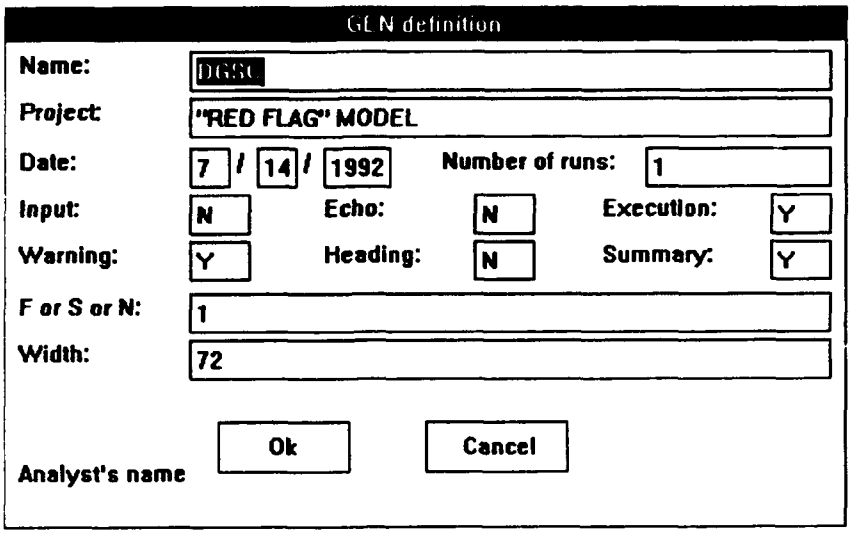

Figure 3-7. GEN Statement Definition

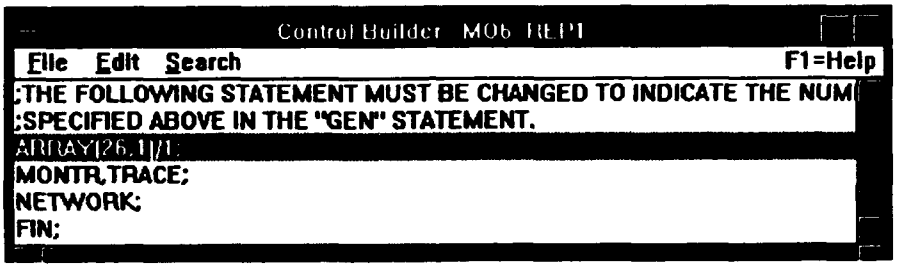

Figure 3-8 . ARRAY(26,1) Statement

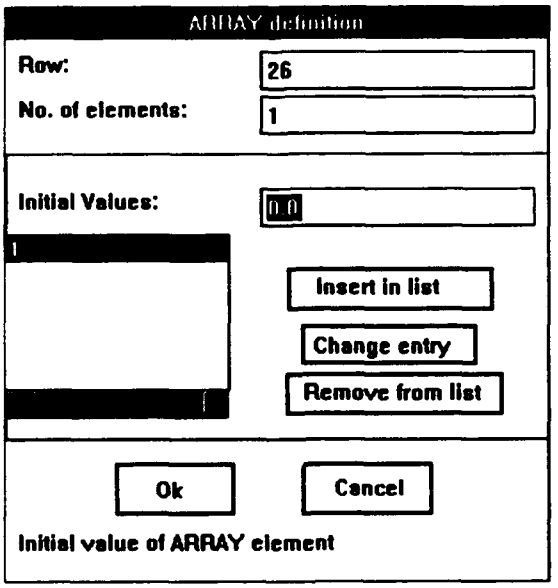

Figure 3-9. ARRAY(26,1) Statement Definition

3.4.2 "RUN TIME"

The "INITIALIZE..." statement in the control file, MO6_REP1, must be modified in order to specify the "run time" or simulation duration. To specify the run time, scroll back to the top of the file (see Figure 3-6) and double click the left mouse button on the "INITIALIZE..." statement. This will bring up the INITIALIZE definition box (see Figure 3-10). Highlight the "Ending time:" box, enter the new value then select **OK**. The simulation time-step is 1 hour with an 8 hr./day, 40 hr./wk., 160 hr./mo., etc.. Therefore, a 6 month simulation would have an ending time value of 960. However, to prevent the simulation from attempting to read the next month's workload data, the run time should actually be set to a value slightly less than the desired time. For example, set the run time to 959.9 vice 960 so that the model will not look for month 7 data at the instant month 6 is over.

3.4.3 EXITING THE CONTROL FILE

After making changes to the control file, select **File**, then **Save** or **Save As** (see Figure 3-11) to save the changes. Finally, select **File**, then **Exit** (see Figure 3-12) to return to the SLAMSYSTEM Main Menu.

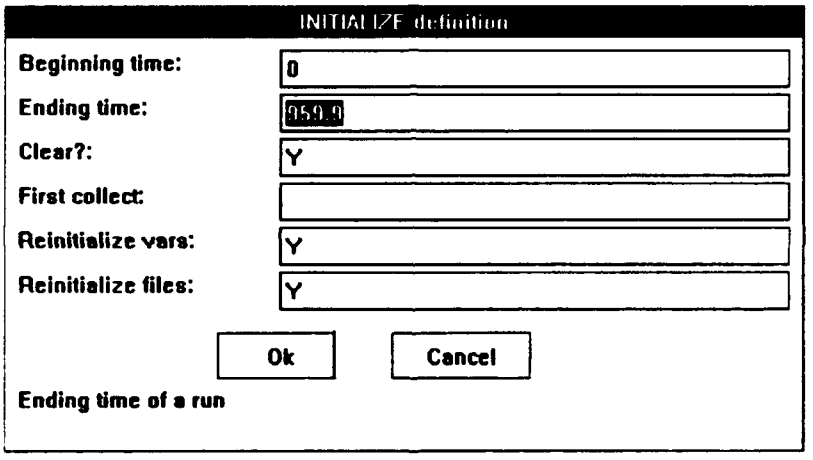

Figure 3-10. INITIALIZE Statement Definition

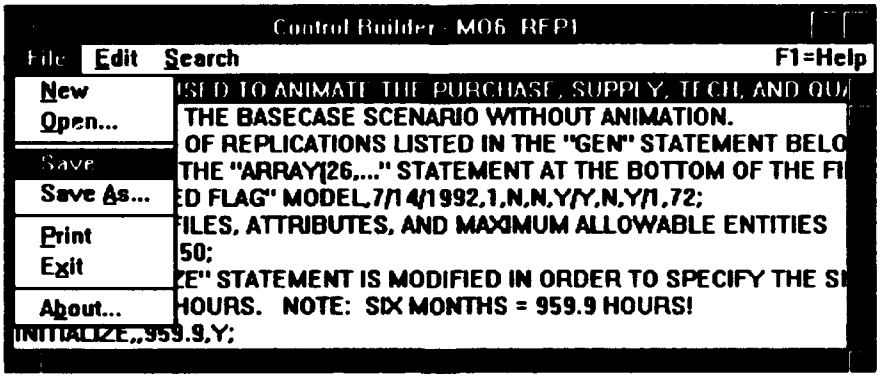

Figure 3-11. Control Builder "Save"

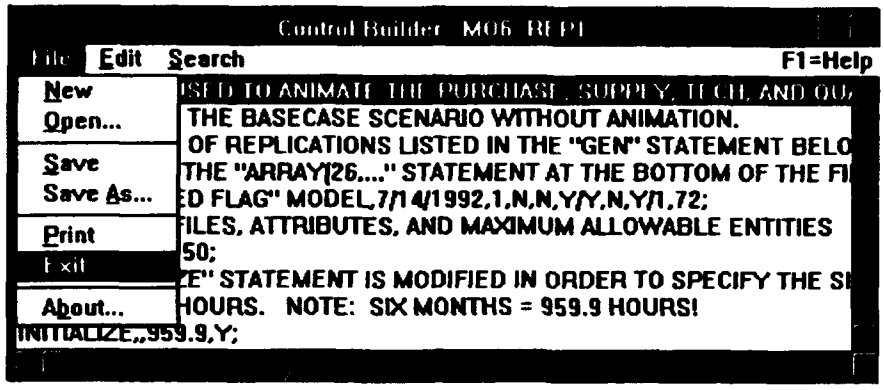

Figure 3-12. Control Builder "Exit"

SECTION 4
RUNNING THE MODEL

Once the specific model has been selected and the parameters set, the simulation may be run by selecting **Simulate**, then **Run** from the SLAMSYSTEM Main Menu (see Figure 4-1).

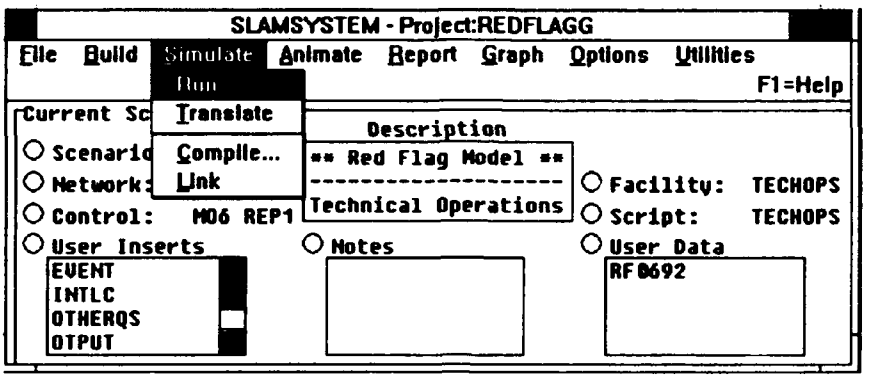

Figure 4-1. Simulate - Run Menu

4.1 SELECTING REQUIRED "UPDATES"

When the Simulate - Run option is selected, SLAMSYSTEM will determine if any system files have been modified since the last time the model was run. If so, the Required Updates Menu (see Figure 4-2) will be displayed. SLAMSYSTEM will recommend the required updates. These recommendations may be "toggled off" by selecting the desired update and clicking the left mouse button (this removes the X in the box). SLAMSYSTEM will also want to "Update Scenario" to recognize all current changes. This option may also be "toggled off" by selecting "Continue without updating scenario". The only time you would want to run the model without updating is when you do not want the most recent changes to the system files to take effect. In order to run the Red Flag model, the only system file to change would be the control file. However, SLAMSYSTEM will view this as a change to the model and will attempt to "translate" the control and network statements.

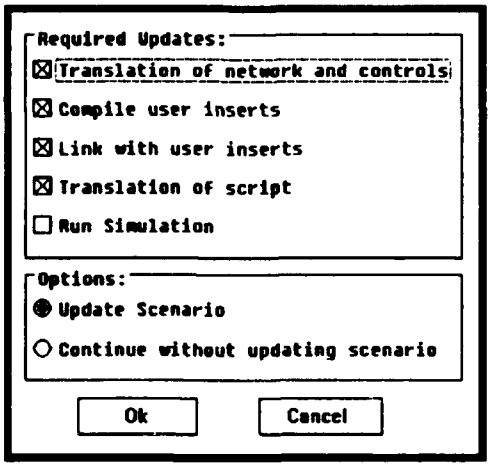

Figure 4-2. Required Updates Menu

4.2 PROBLEMS / ERROR MESSAGES

As SLAMSYSTEM makes the required updates and/or runs the simulation, it will notify you of any translation and/or run time error and direct you to the appropriate output report. To view the error information, select **Report**, then **Output...** from the SLAMSYSTEM Main Menu (see Figure 4-3). This will bring up the Select Output Report Menu (see Figure 4-4). As specified by the error message, select either the **Echo** report for translation errors, or the **Intermediate** report for run time errors.

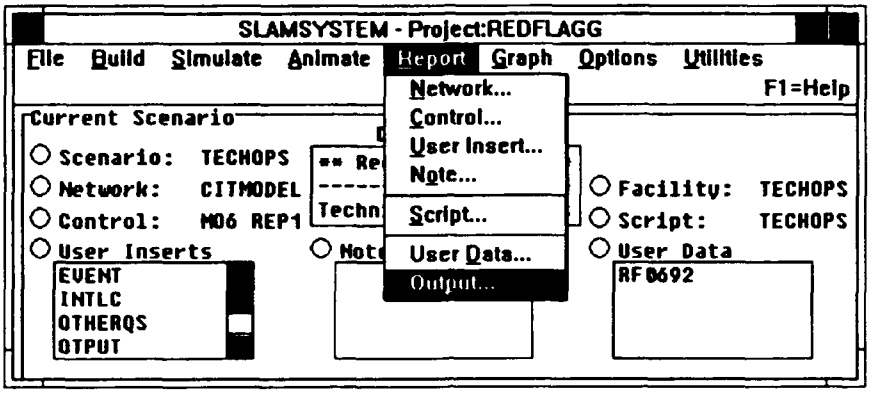

Figure 4-3. Report - Output Menu

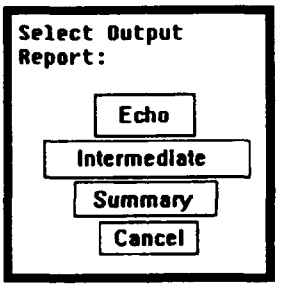

Figure 4-4. Select Output Report Menu

4.3 RESPONDING TO MODEL PROMPTS

If there were no translation errors detected by SLAMSYSTEM then the model will prompt the user for an output file name, an input file name, and a decision whether or not to run CIT workload.

4.3.1 OUTPUT FILE NAME

The model writes simulation results to the output file. For reasons discussed later, it is recommended that the output file name have a DAT extension. The prompt for the output file name is shown in Figure 4-5. If the file already exists, the model will issue a warning and offer the choice of overwriting the file or not. If "N" is selected, the model will prompt the user for a new name.

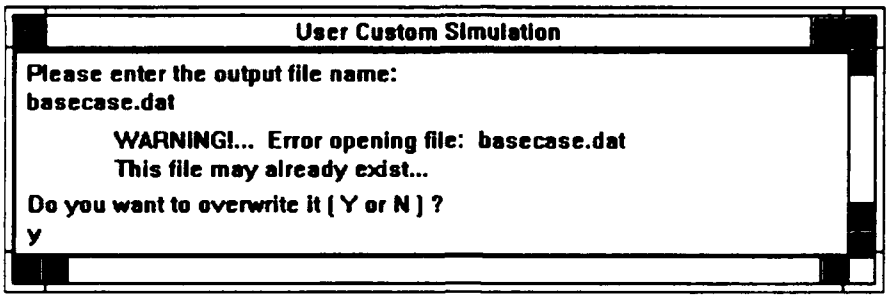

Figure 4-5. Model Prompt (Output File Name)

4.3.2 INPUT FILE NAME

The model uses the input file to read in all of the user specified input data. The prompt for the input file name is shown in Figure 4-6. If the model cannot find the specified file or, for any other reason cannot open the file, it will write a statement saying so and provide the user the chance to open another file.

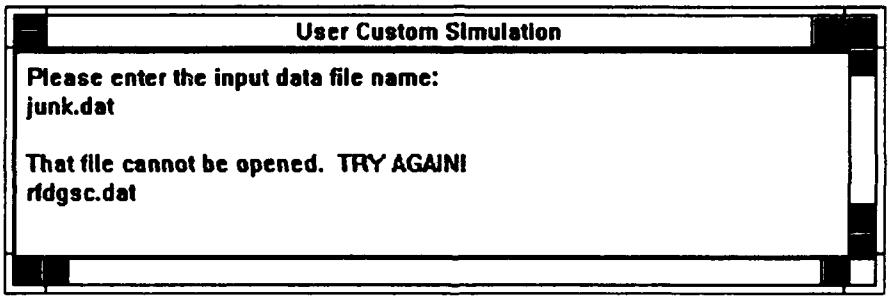

Figure 4-6. Model Prompt (Input File Name)

4.3.3 CIT WORKLOAD GENERATION?

Finally, a decision whether or not to generate CIT workload is required (see Figure 4-7). The model can simulate user provided CIT data or ignore it. If no CIT data is provided in the input file, the No option for "...CIT workload generated...?" must be selected.

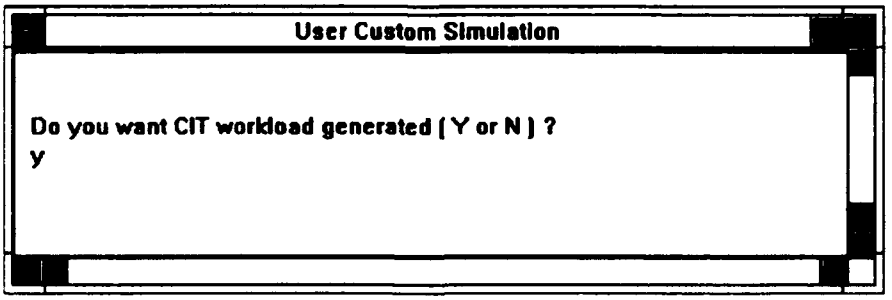

Figure 4-7. Model Prompt (CIT Workload)

4.4 SIMULATION STATUS

Once the user has correctly responded to all of the model prompts, the simulation will begin. A Simulation Status screen is displayed in SLAMSYSTEM's User Custom Simulation box (see Figure 4-8). The first line states that the model is simulating the scenario. The next line shows the current simulated time in hours (TNOW). This is provided as an indicator of how far along the model has come (e.g., 860 out of 960 simulated hours) and is updated in increments of 4 simulated hours. This line will not appear immediately, however,it will appear within several minutes (after the initialization process has been completed). The next three lines echo the user responses to the model prompts. Finally, the current replication number and the desired number of replications are displayed.

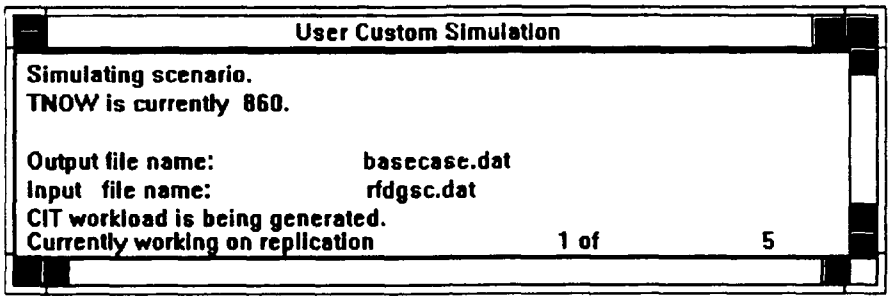

Figure 4-8. Simulation Status Screen

SECTION 5
MODEL RESULTS

When the simulation is complete, three main sources of information concerning model results are available; the animation (optional), the user specified output file, and graphical output.

5.1 ANIMATION

If an animation generating scenario (PURCHASE, TECHOPS, SUPPLY, or QUALITY) was selected there will be a captured animation under the corresponding scenario name (i.e., PURCHASE.CAP, etc.). Animations display a dynamic representation of personnel utilization information and on-hand-balance (red flag) information. To view an animation, select **Animate**, then **Run** from the SLAMSYSTEM Main Menu (see Figure 5-1). If an Updates Menu (see Figure 4-2) appears, the user must decide whether to "Continue without updating scenario" (this is typically the case to view a previously captured animation) or to let the model update and run the simulation. If there is no animation replay file available for the current scenario, SLAMSYSTEM will say so. If there is an animation replay file, the Animation Replay Parameters menu (see Figure 5-2) will appear. The number of "Real time(sec.):" may be highlighted and changed to slow down the animation replay if replaying the animation at the fastest speed (seconds = 0) is too fast. To view the animation, select **OK**. Once the animation is running, use the F1 key to view the main screen, the F2 key to view the system's overview screen, the F5 key to terminate the animation, and any other key to pause/resume viewing.

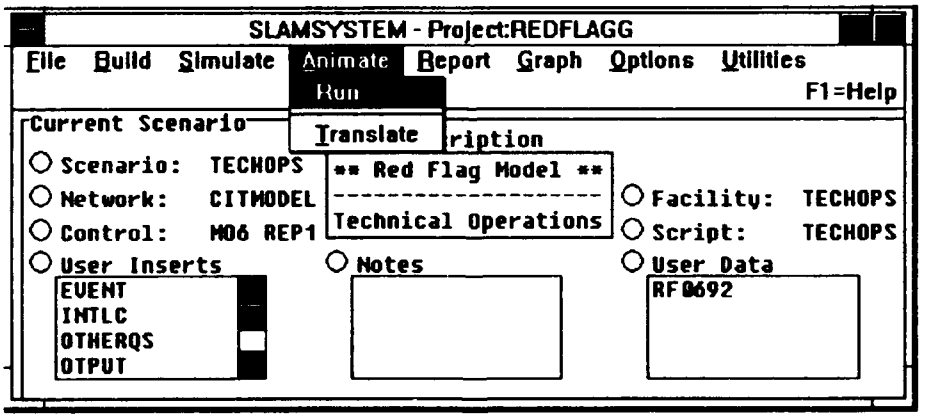

Figure 5-1. Animate - Run Menu

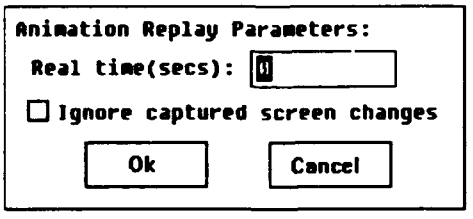

Figure 5-2. Animation Parameters Menu

5.2 USER SPECIFIED OUTPUT FILE

User specified output files contain average, standard deviation, maximum, etc., values for personnel utilization and on-hand-balances. Additionally, a simulation variance analysis is provided if the number of replications is greater than one. These files may be accessed by selecting **User Data** from the SLAMSYSTEM Main Menu (see Figure 3-3) if they have a DAT extension. Only files with the DAT extension are listed in User Data. Upon selecting **User Data** from the main menu, the Select User Data: Menu (see Figure 5-3) is displayed. Files listed as "Available User Data:" may be added-to or removed-from the "Current User Data". Files listed as "Current User Data" will be displayed in the **User Data** box in the SLAMSYSTEM Main Menu (see Figure 3-3). User Data files may be viewed (if they are less than 32K bytes in size -- approximately 3 replications; if they are greater than 32K bytes, then another editor, e.g., Windows Notepad, must be used to view/print the file) by selecting the file (i.e., **BASECASE**), then **OPEN**. To leave the output file, select **File**, then **Exit** from the User Data editor (see Figure 5-4).

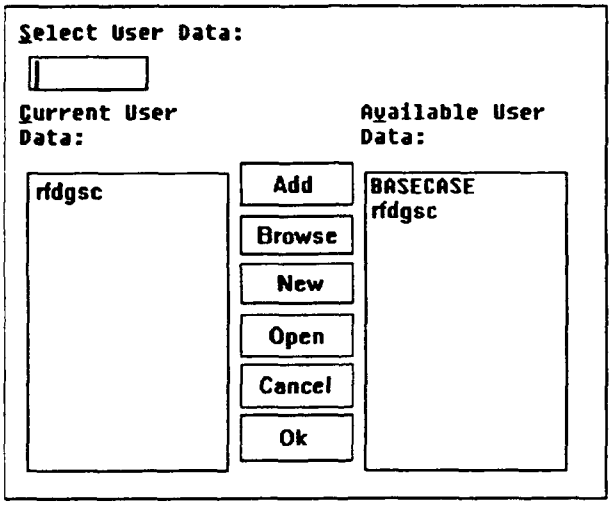

Figure 5-3. User Data Menu

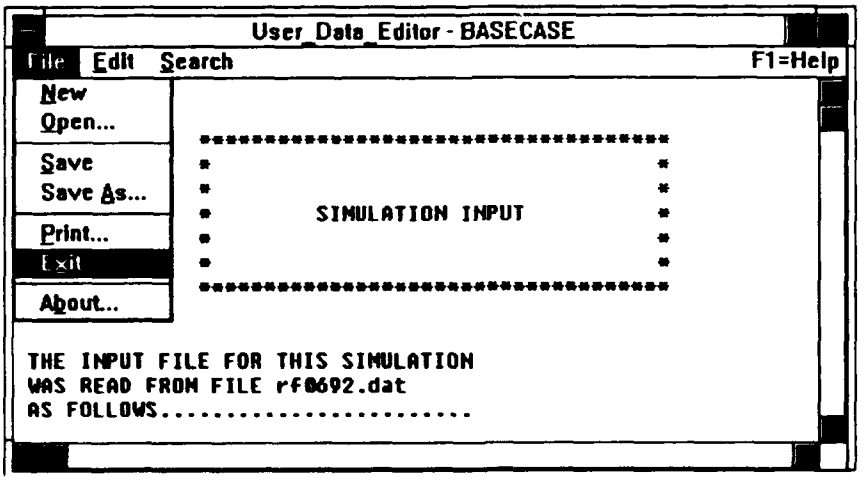

Figure 5-4. Exit User Data

5.3 GRAPHICAL OUTPUT

Graphical output, which provides on-hand-balance values versus simulated time, is available. To view and/or print these plots, select **Graph**, then **Output...** from the SLAMSYSTEM Main Menu (see Figure 5-5). This will bring up the Select Output Graph Type Menu (see Figure 5-6). Selecting **Plot** will bring up the Select Independent and Dependent Variables Menu (see Figure 5-7). The independent variable in all cases is simulated time. The unit in parenthesis (e.g., 55) is used to specify; Supply information (55), Contracting and Production information (56), Quality Assurance information (57), and Technical Operations information (58). After highlighting the desired directorate and the desired dependent variable (i.e., under Supply, Recommended Buys), select **OK** to view the plot. After viewing and/or printing the graphical output, select **Cancel** (see Figures 5-7 and 5-6) to return to the SLAMSYSTEM Main Menu.

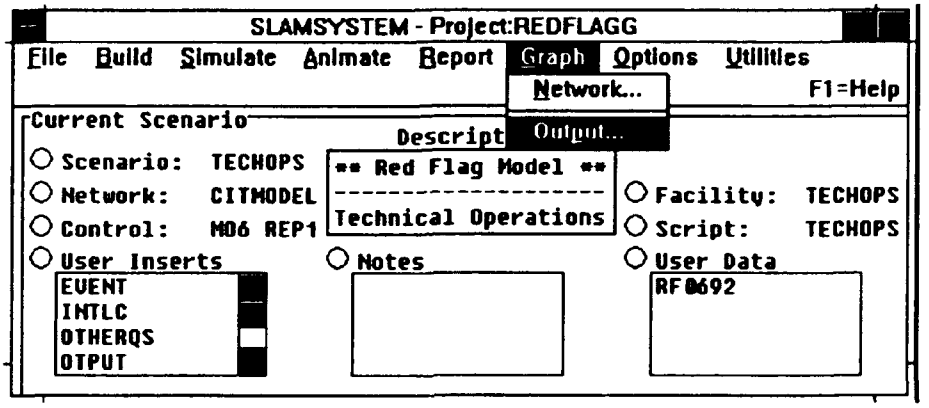

Figure 5-5. Graphical Output Menu

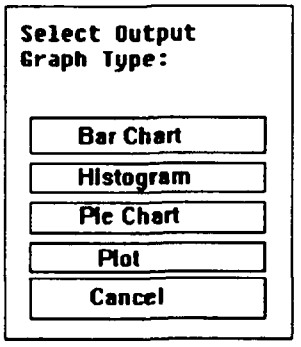

Figure 5-6. Graph Type Menu

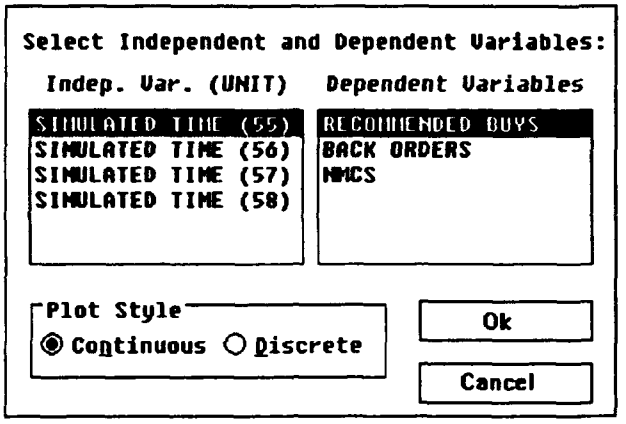

Figure 5-7. Independent and Dependent Variable Selection

SECTION 6
ENDING THE SESSION

To end the current session, Select **File**, then **Exit** at the SLAMSYSTEM Main Menu (see Figure 6). Then select **Yes** or **No** (as desired) to the questions; Save Scenario? and Save Model?.

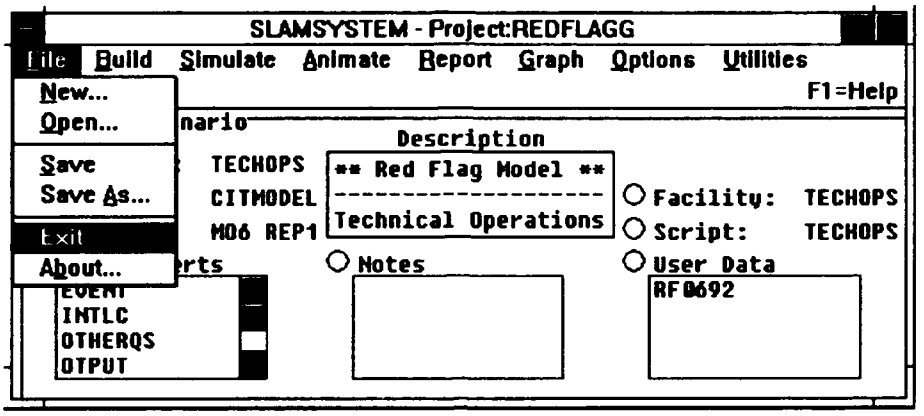

Figure 6. Main Menu Exit

SECTION 7
LOTUS 3.0 INPUT DATA PREPROCESSOR

7.1 GENERAL INFORMATION

The file specified as the SLAMSYSTEM input data file, in 4.3.2 above, contains all of the user input data for the simulation model. Specifically, this file contains workload, beginning on-hand-balance (OHB), personnel, and task performance time data for the four simulated directorates (Supply Operations, Technical Operations, Quality Assurance, and Contracting and Production). This data can be modified, then saved for use in the Red Flag model, by using the LOTUS 3.0 spreadsheet provided during installation of the model. The preprocessor macro instructions and part of the Supply Operations input data set are shown in Figure 7.

7.2 USER ACCESSIBLE DATA

All highlighted (typically in green when viewed in LOTUS) data can be modified by the user. This includes the default directory, the input file name, the worksheet name, and all input data for the four directorates.

7.2.1 DEFAULT DIRECTORY

The default directory specifies where the spreadsheet will locate and/or place the spreadsheets and SLAMSYSTEM input files to be modified/created. This can be any directory on the system. Once this value has been entered into the cell, press the Alt and D keys to activate the Alt D macro. The tilde (~) is required at the end of these inputs in order to run the macros. The Alt D macro sets the current Lotus directory to the default directory. This should be done first upon calling up the spreadsheet so that files will not accidentally be placed in the wrong directories.

7.2.2 INPUT FILE

The SLAMSYSTEM input file name will be the same as that specified in 4.3.2. This is the file the model will read for the current simulation. The name must be unique, that is, the file must be a new file which does not currently exist in the default directory. Once this name has been entered, the Alt W macro will write the file to the default directory. For example, running the Alt W macro given the information in Figure 7 will create the file RFDGSC.DAT in the directory C:\PROJDOS\REDFLAGG if that file does not already exist. Do this after making changes to the input data.

7.2.3 WORKSHEET NAME

When changes have been made to the worksheet, they may be printed by using the Alt P macro or saved to disk using the Alt S macro. DLA-DORO will provide a default input data worksheet (e.g., RFDGSC.WK3) quarterly as a standard. This file cannot be overwritten. Also, in order for the Alt S macro to work, the worksheet name must be unique (as described in 7.2.2 for the input file name). For example, running the Alt S macro given the data in Figure 7 would result in an error because RFDGSC.WK3 would already exist in C:\PROJDOS\REDFLAGG. However, if the worksheet name were changed to RF001.WK3~, running the Alt S macro will create worksheet file RF001.WK3 in C:\PROJDOS\REDFLAGG.

7.2.4 INPUT DATA

All of the input data for the four directorates are in unprotected cells and may be modified by the user. All changes to the workload, beginning OHB, personnel, and task performance time data should be made prior to running the Alt P, Alt W, and Alt S macros.

SLAMSYSTEM'S "RED FLAG" MODEL, INPUT PREPROCESSOR
for the DEFENSE GENERAL SUPPLY CENTER

Depress the "Alt" key and appropriate letter (as described below).
Alt D -- Sets the default directory (Do this first!).
Alt P -- Prints the worksheet.
Alt W -- Writes the SLAMSYSTEM file to disk.
Alt S -- Saves the worksheet and SLAMSYSTEM file to disk.

ENTER DEFAULT DIRECTORY BELOW:
C:\PROJDOS\REDFLAGG\" <==NOTE: MUST HAVE " AT END OF NAME.

ENTER SLAMSYSTEM's INPUT FILENAME BELOW: NOTE: MUST USE A "NEW" FILENAME FOR THE Alt W MACRO TO WORK!
RFDGSC.DAT" <==NOTE: MUST HAVE " AT END OF NAME.

ENTER A NEW WORKSHEET NAME BELOW: NOTE: RFDGSC.DEF IS WRITE PROTECTED! SAVE THIS FILE TO ANOTHER NAME!
RFDGSC.WK3" <==NOTE: MUST HAVE " AT END OF NAME.

SUPPLY OPERATIONS

WORKLOAD DATA ***

FORECAST FOR:	MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6
--NON-CIT GENERATED--						
RECOMMENDED BUYS (RB)..	11598	13948	11661	12913	9305	7384
MANUAL REQs (MR).....	40297	41674	45199	40389	37301	34565
DIRECT VENDOR DEL (DVD)	5129	5304	5753	5140	4747	4399
BACKORDERS (BO) EST'D..	41518	42937	46569	41613	38431	35613
NON-MISS-CAP-SUP (NMCS)	5411	5326	6070	5425	5011	4644

FORECAST FOR:	MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6
---CIT GENERATED----						
RECOMMENDED BUYS (RB)..	1479	1777	1488	1641	1182	944
MANUAL REQs (MR).....	715	836	1038	1257	1335	1385
DIRECT VENDOR DEL (DVD)	61	72	89	108	114	119
BACKORDERS (BO) EST'D..	3883	4539	5633	6826	7248	7519
NON-MISS-CAP-SUP (NMCS)	225	263	326	395	419	435

BO BEGINNING OHB.....	147888		
RB APPROVAL RATE (%)...	33.00%		
MINIMUM RB $ VALUE.....	$100		
MINIMUM DVD $ VALUE....	$50		
AUTO RB $ VALUE MINIMUM	$1,500	AUTO RB %.....	25.00%

Figure 7. LOTUS 3.0 Input Data Preprocessor

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13. ABSTRACT *(Maximum 200 words)*

The transfer of management of nearly one million consumable items from the military services to the Defense Logistics Agency (DLA) during the period FY91 - FY94 may adversely affect certain key processes and backlogs at the four DLA hardware supply centers. Specifically, "bottlenecks" or "choke points" could develop within the four hardware centers as a result of overtaxed resources. Therefore, the DLA Operations Research Office (DLA-DORO) has developed a computer simulation of these key supply center processes and backlogs. The Red flag Model is so named because measurement of each process or backlog is accomplished through the use of indicators which track the entire range of operating levels from normal to out of tolerance (i.e., red flag) levels. Furthermore, the model enables the hardware centers to identify potential problem areas 4 to 6 months in advance and take appropriate corrective actions. The model is currently installed at each hardware center.

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